BTEC Assignment Brief

Qualification	Pearson BTEC International Level 3 Diploma in Engineering Pearson BTEC International Level 3 Extended Diploma in Engineering
Unit number and title	**Unit 31: Thermodynamic Principles and Practice**
Learning aim(s)	**B:** Investigate energy transfer in thermodynamic systems and applications of closed and open loop systems
Assignment title	Investigate applications of thermodynamic systems
Assessor	
Issue date	
Hand in deadline	
Vocational Scenario or Context	Your supervisor is pleased with the work that you have done in producing your report that explains the principles of thermodynamics. He would now like you to investigate open and closed loop thermodynamic systems. He would also like you to examine energy transfer within the systems and consider how the laws of thermodynamics are applied to these systems. He would then like you to consider the relationship between thermodynamic principles and parameters and then perform calculations to determine values related to thermal energy for the systems.
Task 1	You are now to produce a written report which: a) explores given applications of open- and closed-loop thermodynamic systems, b) applies the laws of thermodynamics to calculate work done, thermal energy transfer and system efficiencies for given thermodynamic systems, and c) evaluates the laws of thermodynamics and how these are applied to the given thermodynamic systems. **To do this.** Your tutor will provide you with examples of open-loop and closed-loop thermodynamic systems that you are to research and investigate, along with suitable data that will allow you to carry out calculations to an appropriate degree of accuracy and using appropriate units throughout. Your report should contain: • research into your given applications of thermodynamic systems and identify the similarities and differences between the open- and closed-loop systems. • calculations to determine the values of (using the data provided for both a Stirling engine and a heat exchanger): a. work done in the system b. output energy from the system c. energy losses from the system d. overall system efficiency e. Overall thermal energy transfer. Using the results of your calculations you then need to produce a balanced evaluation of how the First and Second Law of

	Thermodynamics are applied to your given open- and closed-loop thermodynamic systems. You should: a) consider the interrelationships of the thermodynamic principles and parameters which act on the two systems, b) consider the advantages and disadvantages of the two different types of system c) explain the significance of energy losses on the efficiencies of your given systems, referring to your calculations, and d) provide a suitable conclusion.
Checklist of evidence required	A report which focuses on the energy transfer principles for both open- and closed-loop thermodynamic systems in given engineering applications. You should include diagrams and calculations to support your findings.

Criteria covered by this task:	
Unit/Criteria reference	To achieve the criteria you must show that you are able to:
31/B.D2	Evaluate, using the First and Second Laws of thermodynamics, open and closed loop thermodynamic systems in given engineering applications, calculating work done, energy transfer and efficiency accurately
31/B.M3	Analyse, using the First and Second Laws of thermodynamics, open and closed loop thermodynamic systems in given engineering applications, calculating work done, energy transfer and efficiency accurately.
31/B.P4	Explain the differences between open and closed loop thermodynamic systems used in given engineering applications
31/B.P5	Calculate work done, thermal energy transfer and efficiency in given open and closed loop thermodynamic systems

Sources of information to support you with this Assignment	**Books** Nag, P.K.; Engineering Thermodynamics, 2008, McGraw-Hill, ISBN 9780070260627 Rayner, J.; Basic Engineering Thermodynamics, 1996, Pearson Education, ISBN 9788131718889 **Websites** grc.nasa.gov/www/k-12/airplane/thermo.html - NASA website which covers thermodynamics resources may be found at qualifications.pearson.com/en/support/published-resources.html#step1

Note to assessor:

<table>
<tr><td>Scenario</td><td>Appropriate closed systems include: internal combustion engines, refrigeration systems, four-stroke piston engines, and Stirling engines.
Appropriate open systems include: coolers, rotary compressors, heat exchangers, and gas turbine engines.</td></tr>
<tr><td>Task 1, 2, 3 etc.</td><td>Data for a closed thermodynamic system (Sterling Engine)
Assume a specific gas constant of 2077 $Jkg^{-1}K^{-1}$ a mass of 1kg and c_v=717 $Jkg^{-1}K^{-1}$
<table>
<tr><th rowspan="2">Learner</th><th rowspan="2">Heat energy input (Q_{in}) (J)</th><th colspan="2">Temperature (K)</th><th colspan="2">Volume (m^3)</th></tr>
<tr><th>Cold (K)</th><th>Hot (K)</th><th>Maximum (V_{max})</th><th>Minimum (V_{min})(m^3)</th></tr>
<tr><td>1</td><td>3000</td><td>373</td><td>500</td><td>0.4</td><td>0.2</td></tr>
<tr><td>2</td><td>3500</td><td>363</td><td>550</td><td>0.5</td><td>0.2</td></tr>
<tr><td>3</td><td>4000</td><td>403</td><td>600</td><td>0.6</td><td>0.3</td></tr>
<tr><td>4</td><td>2500</td><td>383</td><td>650</td><td>0.7</td><td>0.3</td></tr>
<tr><td>5</td><td>1000</td><td>373</td><td>700</td><td>0.5</td><td>0.3</td></tr>
<tr><td>6</td><td>1500</td><td>393</td><td>750</td><td>0.3</td><td>0.1</td></tr>
<tr><td>7</td><td>3000</td><td>413</td><td>800</td><td>0.7</td><td>0.4</td></tr>
<tr><td>8</td><td>3500</td><td>353</td><td>850</td><td>0.6</td><td>0.4</td></tr>
<tr><td>9</td><td>2500</td><td>363</td><td>900</td><td>0.8</td><td>0.5</td></tr>
<tr><td>10</td><td>2000</td><td>393</td><td>950</td><td>0.4</td><td>0.1</td></tr>
</table>
Data for an open thermodynamic system (air cooled heat exchanger):
Assume the output from the open system is venting in to the atmosphere.
<table>
<tr><th rowspan="2">Learner</th><th rowspan="2">Heat energy input (Q_{in}) (J)</th><th colspan="2">Temperature (K)</th><th rowspan="2">Exchanger Volume (m^3)</th><th rowspan="2">Heat transfer coefficient (U) ($Wm^{-2}K^{-1}$)</th></tr>
<tr><th>Cold</th><th>Hot</th></tr>
<tr><td>1</td><td>600</td><td>273</td><td>450</td><td>0.2</td><td>230</td></tr>
<tr><td>2</td><td>700</td><td>283</td><td>500</td><td>0.4</td><td>340</td></tr>
<tr><td>3</td><td>800</td><td>303</td><td>500</td><td>0.6</td><td>400</td></tr>
<tr><td>4</td><td>900</td><td>353</td><td>650</td><td>0.8</td><td>900</td></tr>
<tr><td>5</td><td>800</td><td>373</td><td>550</td><td>0.5</td><td>680</td></tr>
<tr><td>6</td><td>700</td><td>363</td><td>600</td><td>0.2</td><td>1160</td></tr>
<tr><td>7</td><td>600</td><td>403</td><td>550</td><td>0.4</td><td>1060</td></tr>
<tr><td>8</td><td>500</td><td>323</td><td>450</td><td>0.6</td><td>280</td></tr>
<tr><td>9</td><td>600</td><td>393</td><td>500</td><td>0.8</td><td>455</td></tr>
<tr><td>10</td><td>700</td><td>413</td><td>650</td><td>0.7</td><td>910</td></tr>
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